Richmond Refinery LPS Bulletin – Reliability

Inter-Reactor Quench Exchanger Temperature Swing Gasket Leak

Impact ERM: 36512

Location:
Hydroprocessing Division, RLOP - Heavy Neutral Cracker (HNC)

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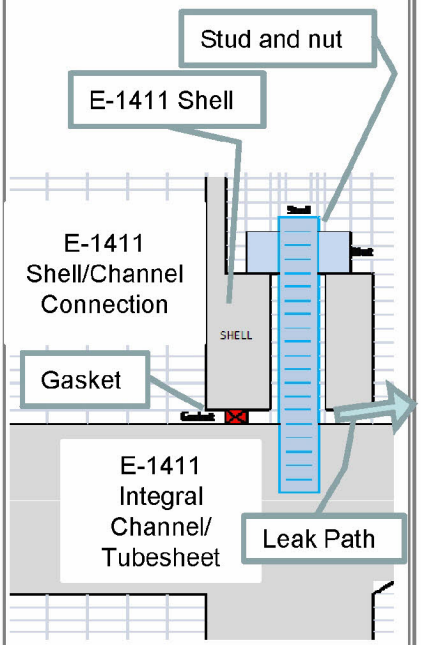
Reference:
Investigation # 22506



E-1411 Shell/Channel Connection

Tenet of Operations Violated:

Tenet #10 – Always involve the right people in decisions that affect procedures and equipment.

Emergency shutdown conditions were not adequately considered for the closure design of the E-1411 channel-to-shell joint.

Incident Description:

At 12:30 pm on April 26, 2012, the HNC startup was delayed when the E-1411 Inter-Reactor Quench Exchanger began to leak at the channel-to-shell connection. This leak occurred about 12 hours after an unplanned HNC shutdown due to a cable failure of the Recycle H2 Compressor Turbine TK-1400 thrust monitoring system. (Refer to Loss # 36434 and TapRooT Investigation # 22505.) Operations responded quickly by discontinuing the HNC startup, but the leak continued. Maintenance responded by hot-torquing the exchanger head, installed new nuts, and reestablished the torque on the E-1411 channel-to-shell connection.

Investigation Findings:

1) Loss of recycle flow at HNC resulted in implementation of emergency shutdown procedures which caused a rapid temperature drop on the E-1411 shell-side relative to the hot tube-side inlet temperature.
2) E-1411 is susceptible to low gasket stress and subsequent leakage if the exchanger shell is cooled substantially and rapidly relative to the channel section.

Lessons Learned :

1) Initial gasket stress was greatly reduced due to the manner in which the unit is operated during the emergency shutdown.
2) Allowances for the dynamic loading and unequal heat distribution as part of the emergency shutdown procedures were not included in the closure design calculations for this exchanger.

Recommendations:

1) Develop a new gasket closure procedure that can withstand unexpected thermal gradients during unplanned emergency HNC shutdowns.
2) Implement hot torquing of E-1411 with the new gasket closure procedure developed by the Design Engineering Department at the next available opportunity.
3) Design Engineering to review other heat exchanger units in similar service where significant process induced temperature swings could effect gasket stress to verify that current torquing procedures are adequate.
4) Review engineering procedures and guidance for establishing flange closure calculations. Specifically review the adequacy in addressing alternate (non-steady state) load cases.